Lesson Plan Information Sheet

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Introduction/Abstract to Lesson Plan (max. 100 Words) Include aspects of the lesson that are unique and innovative.	In this lesson, students learn about an example of how nature can slowly change the appearance of an animal using the process of selection. In the activity, "Bees in the Flower Fields," students simulate how natural selection affects a group of bees in a flower field when the sizes of flowers begin to change. This simulation only works for groups of 16 or more students.
List of Standards Addressed (This should be list of all full standards addressed by the lesson.)	S7L3. Obtain, evaluate, and communicate information to explain how organisms reproduce either sexually or asexually and transfer genetic information to determine the traits of their offspring.
Learning Objectives using Measurable Verbs (what students will be able to do)	Students will understand that populations change over time. Students will interpret and compare bar graphs. Students will understand that traits can be inherited from one generation to another.
Appropriate Grade Levels	4^{th}-7^{th} grade
Group Size/# of students activities are designed for	Up to 30 students
Setting (e.g. indoors, outdoors, lab, etc.)	Indoors
Approximate Time of Lesson (Break down into 20-50 minute periods)	30-45 minutes
Resources Needed for Students (e.g. scissors, paper, pencils, glue, etc.)	Pencils
Resources Needed for Educators (e.g. blackboard, Powerpoint capabilities, etc.)	none
Apps/Websites Needed	none

Lesson Activity (step by step description of activity)	**Introduction** A pollinator is anything that carries pollen from one plant to the pistil (female reproductive organ) of another plant. This is an important process for the reproduction aspect of a plant's life cycle. Flowers have very close relationships with several different types of pollinators. However, when the shapes, sizes, numbers of flowers change, this can create a mismatch between pollinators and flowers.
	Background This activity is based off of a research study where a field of flowers began to decrease in the number of long tube flowers. Because of this, there were no longer flowers that matched with bees that had long tongues. As a result, over the last 40 years, bee populations have increased in the amount of short tongue bees and decreased in the amount of long tongue bees.
	5 E's **<u>Engage</u>** The instructor will open with questions to stimulate thinking, evaluate prior knowledge, and introduce the topics for the activity. Ex. What is a pollinator? What do pollinators do? What are the different types of pollinators? **<u>Explore</u>** Students can be given time to use technology to look up "pollinators" and provide examples. **<u>Explain</u>** The instructor will give a brief lecture/powerpoint presentation with backgound information on pollination, plant reproduction, and mutualism between pollinators and plants, and how that has influenced plant diversity. An example of a 1 to 1 plant mutalism will be provided (wasp orchids) – can be shown as a video or as a lecture example. **<u>Elaborate</u>** Students will consider what the next generation of bees might look like. Students will connect this to the traits they inherited from their parents and consider traits that may not be heritable. Students will provide examples of what might influence a plant or animal's features to change over time. **<u>Evaluate</u>**

	Students will participate in a Kahoot! Activity as an assessment of their understanding. Questions may include: “What are the different ways a plant can be pollinated?” “Why did the bees change over time?” “Was the individual bee able to change the length of it’s own tongue during it’s life?”
	Step by Step Activity Students will be given an “Adopt a Bee” worksheet. The starting population of student bees should be roughly equal among the 3 different worksheet for short tongue bees, medium tongue bees, and long tongue bees. Students will complete their worksheet and the class will get up and form 3 group -- short tongue bees, medium tongue bees, and long tongue bees. As a group, the students will count the number of short tongue bees, medium tongue bees, and long tongue bees. Then, each individual student will complete the “Original Bees” worksheet, where they fill in the bar chart of short tongue bees, medium tongue bees, and long tongue bees. The students will then intermingle between the groups with their “Adopt a bee” worksheet”. The instructor will instruct all long tongue bees to stand, and all medium and short tongue bees to crouch down. The instructor will then take the “Adopt a bee” form from the standing students (long tongue bees) and a few of the medium tongue bees. These bees did not survive to the next generation because they were unable to find a flower that matched their tongue length. (Note: Students that were removed from the population may be re-entered into the population with a new “Adopt a bee” form with a short or medium tongue. This can demonstrate population growth.) The remaining students will be given the “Baby Bee” form and will pair up with another student to determine what the next generation of bees will look like. Students will again form 3 groups for the next generation of short tongue bees, medium tongue bees, and long tongue bees. As a group, the students will count the number of short tongue bees,

	medium tongue bees, and long tongue bees and complete the “Baby Bees” worksheet, completing the bar chart.
	Reflection/Assessment As a group, the instructor will compare with the students the difference between generation 1 and generation 2 of the bees. The instructor will ask students the following questions: -What was the difference between generation 1 and generation 2? -Why are there more short tongue bees in gernation 2? -What is another example that you can think of that might change the characteristics of an animal or plant over time? -What types of traits do we inherit from our parents? What types of traits do we NOT inherit from our parents?
Final Product/Assessment (e.g. quiz, presentation, essay, etc.)	Students will complete a Kahoot! Quiz activity as a group.

Researcher Bio Questionnaire

Thank you for your participation with SciREN Georgia! In preparation for the Annual Networking Event, we hope to learn more about you and your research. Please fill out as much information as you can so we can include you in our printed program, which we will share with educators at the Networking Event.

Name: Summer Blanco (she/her/hers or they/them/theirs)

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Lesson Plan Title, Grade Level, and Keywords:
"Bees in the Flower Fields"
Grade levels: 4^{th}-7^{th} grade
Key words: Trait Variation, Natural Selection, & Survival

Brief Description of Research Interests:

I study the evolution of flower color. My lab works with the common ornamental plants, *Geranium* (common name: Geranium) and *Ipomoea* (common name: morning glory). We want to understand why a specific species of Geranium, *Geranium maculatum*, has purple pigmented pollen in high elevations and white/cream-colored pollen in low elevations. Some of the plant pigments that produce purple coloration are believed to be associated with other plant compounds that can protect pollen and other plant parts from different types of stress. We want to evaluate if this is why we see the distribution of colors in different environments that may be associated with different levels of environmental stress.

The coloration of flowers also influences light (which determines what color is reflected, and what we see with our human eyes). We are also interested in understanding how the relationship between flower pigments and light affects the temperature of different parts of flowers, which could affect their interactions with pollinators like bees!

Name: _____

Original Bees

(Generation 1)

Some bees are better at getting food from all flowers, while others can only get their food from one type!

There are ____ long-tongued bees.

There are ____ medium-tongued bees.

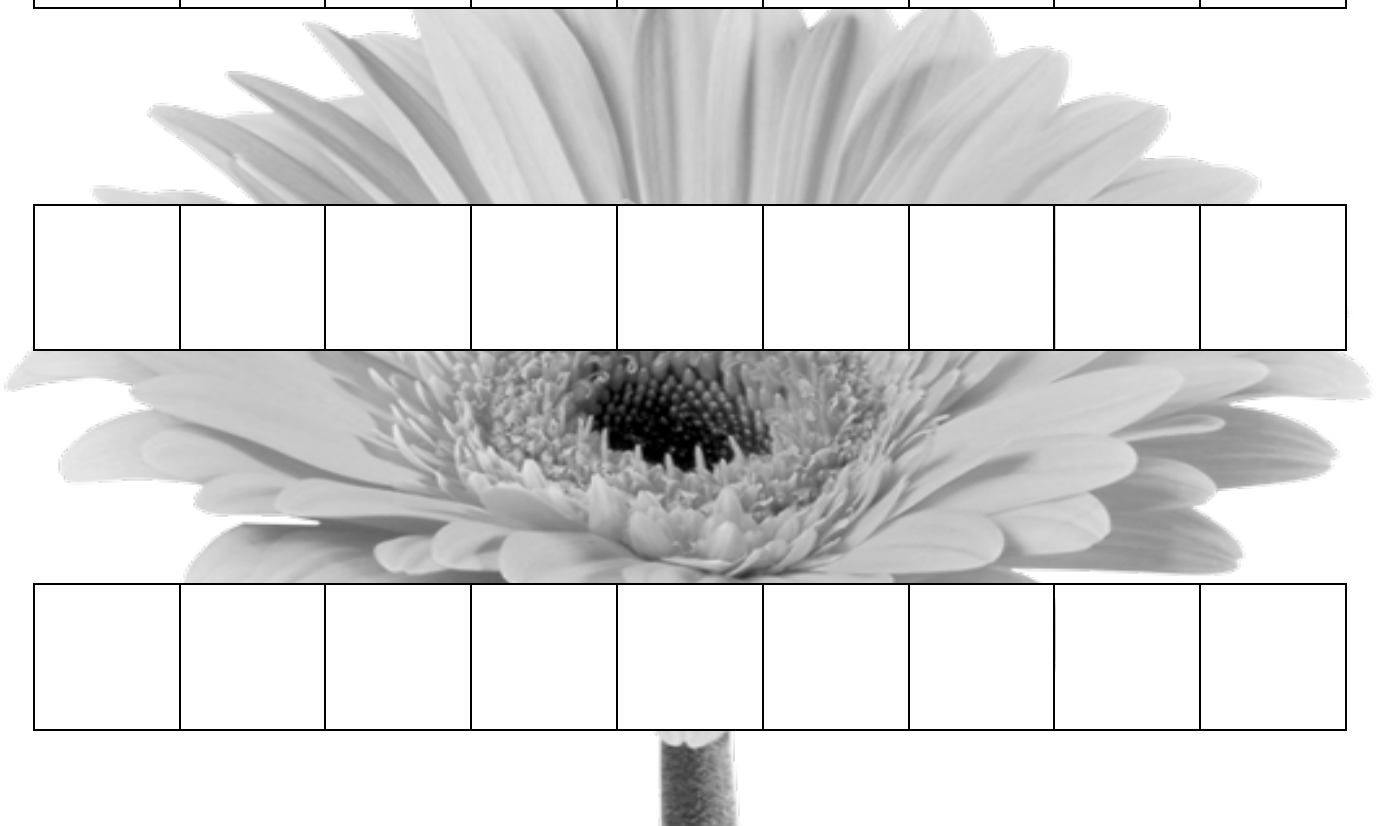
There are ____ short-tongued bees.

To make a Bar Graph, color in a box for each bee:

Long

Medium

Short



Name: _____

Baby Bees

(Generation 2)

This is what the bee babies looked like after the number of long flowers decreased.

There are ____ long-tongued bees.

There are ____ medium-tongued bees.

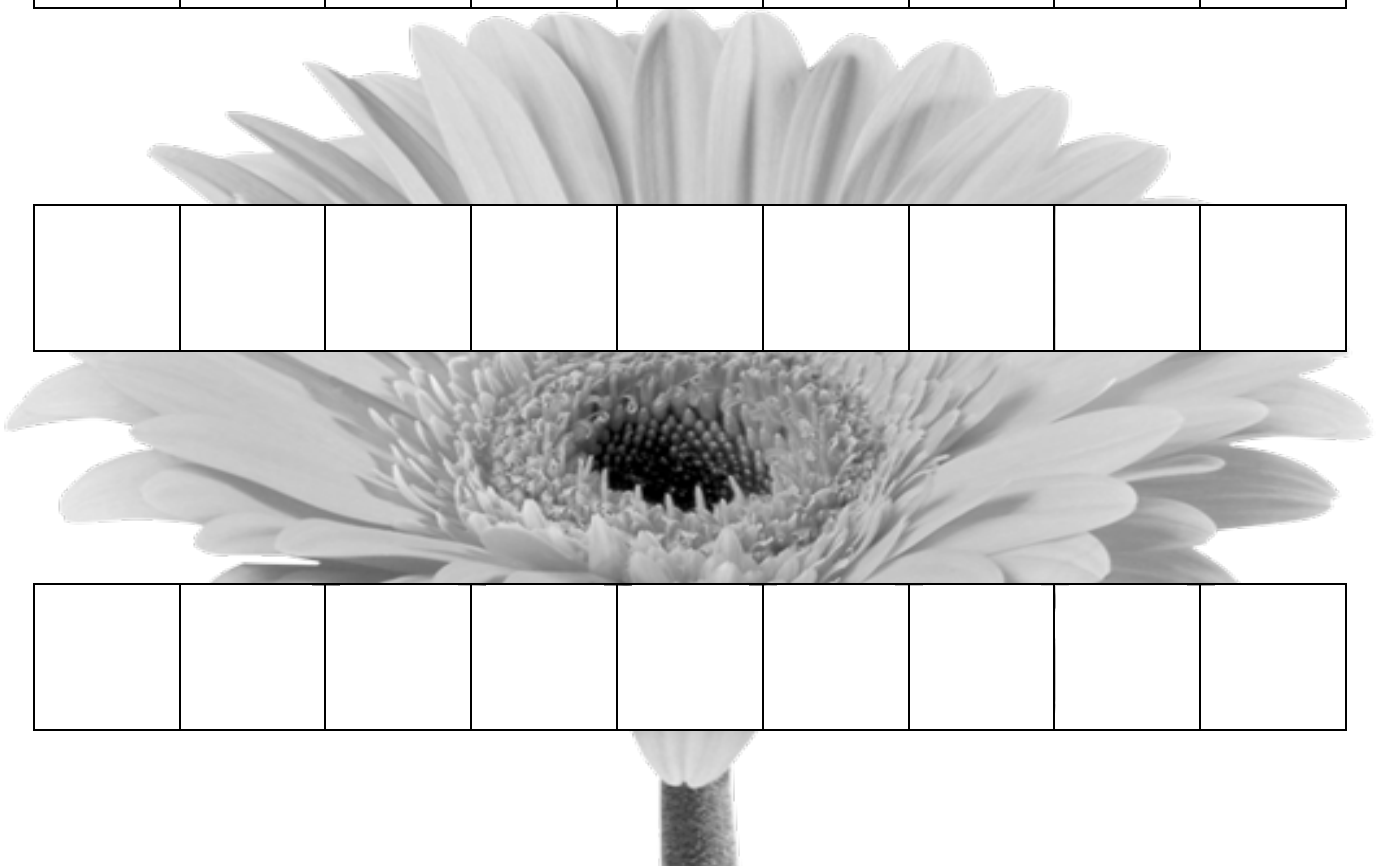
There are ____ short-tongued bees.

To make a Bar Graph, color in a box for each bee:

Long

Medium

Short



Name: _____

Baby Bee

How long is your baby bee's tongue?

Step 1: Write down how longue the tongue of each parent is.

Parent #1: _____ mm

Parent #2: _____ mm

Step 2: Add those numbers together.

Parent #1 tongue length + Parent #2 tongue length =

_____ mm

Step 3: Divide the sum by 2.

The sum divided by 2 equal _____ mm
This is how long the baby bee's tongue is.

Circle the kind of tongue your bee has

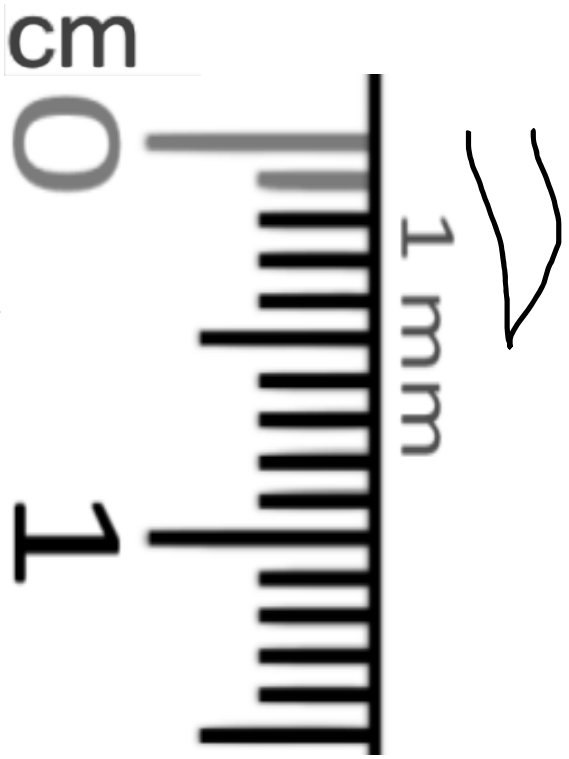
Long
9 mm or longer

Medium
6-8 mm

Short
5 mm or shorter

Name: _____

Adopt a Bee!



My bee's tongue is _____ millimeters long!

Circle the kind of tongue your bee has

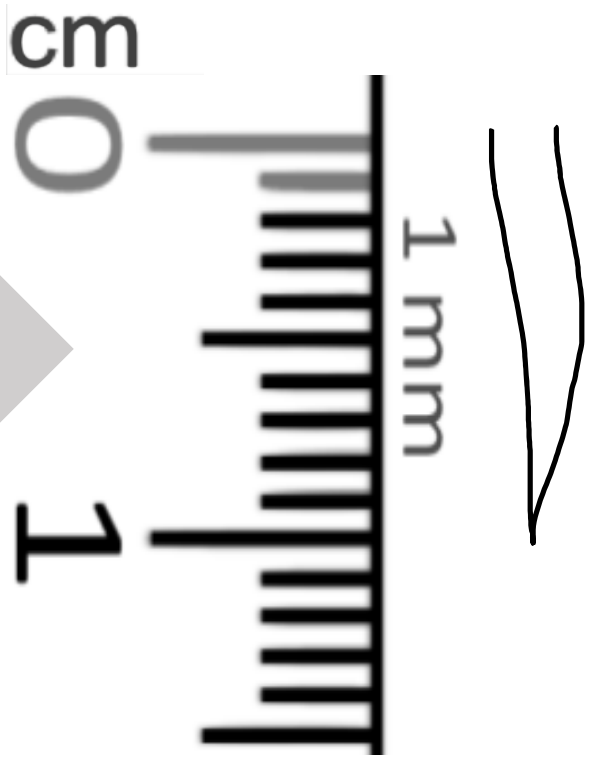
Long
9 mm or longer

Medium
6-8 mm

Short
5 mm or shorter

Name: _____

Adopt a Bee!



Circle the kind of tongue your bee has

Long
9 mm or longer

Medium
6-8 mm

Short
5 mm or shorter

Name: _____

Adopt a Bee!

Circle the kind of tongue your bee has

Long
9 mm or longer

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Short
5 mm or shorter